



Additions to the dragonfly genus *Lauromacromia*, with description of the female of *Lauromacromia luismoojeni* and new distributional records (Odonata: Corduliidae s.l.)

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Taxonomic, morphological and distributional data on three species of the rare South American corduliid genus *Lauromacromia* Geijskes, 1970 are updated based on specimens collected recently and old specimens deposited in natural history collections. The female of the poorly known *Lauromacromia luismoojeni* (Santos, 1967), an endemic species from the Brazilian Cerrado, is illustrated, described and diagnosed for the first time, based on a single specimen from the municipality of Mineiros, state of Goiás. This species was previously known from two males from two different localities: the original description from Distrito Federal, and an additional record from the state of Mato Grosso do Sul. New state records to Brazil are given for *L. dubitalis* (Fraser, 1939) (Amazonia domain of the state of Amapá), *L. luismoojeni* (Cerrado domain of the state of Goiás), and for *L. picinguaba* Carvalho et al., 2004 (Atlantic Forest domain of the state of Paraná). Finally, the current knowledge about the genus is discussed.

Keywords: Anisoptera; Cerrado; distribution; odonates; taxonomy

Introduction

The genus *Lauromacromia* Geijskes, 1970 was described to include a single enigmatic species of Corduliidae s.l., *Gomphomacromia dubitalis* Fraser, 1939. Currently it includes six species (Pinto & Carvalho, 2010), all of which are endemic to South America. The adults are relatively rare in natural history collections. For instance, before the newly discovered population of *L. picinguaba* Carvalho et al., 2004 in southern Brazil (Pinto, 2019 increased to 28 the number of adult specimens of the genus), only 14 adult specimens were known (Pinto & Carvalho, 2010).

Based on a hypothesis of phylogenetic relationships, the genus can be divided in three groups associated with the different phytogeographical domains: Amazonia, i.e. *L. dubitalis*; Atlantic Forest, i.e. *L. melanica* Pinto & Carvalho, 2010 and *L. picinguaba*; and Cerrado, i.e. *L. bedei* Machado, 2005, *L. flaviae* Machado, 2002 and *L. luismoojeni* (Santos, 1967). Except for *L. dubitalis*, a northern South America species, all other species of the genus are endemic to Brazil (Pinto & Carvalho, 2010).

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Even considering their disputed generic position, both *L. dubitalis* and *L. luismoojeni* (the oldest available names) were originally described in the already established Selysian genera *Gomphomacromia* Brauer, 1864 and *Neocordulia* Selys, 1882. Years later, they were associated with *Lauromacromia* by Geijskes (1970) and Garrison (1991), respectively.

Species of *Lauromacromia* are known from few specimens and localities. About half of them are known only from the type series or from a single holotype. *Lauromacromia luismoojeni* was described based on a single male from Distrito Federal, Brazil, and another male was recorded in Cerrado of Mato Grosso do Sul State, bordering the state of São Paulo (Pinto & Carvalho, 2010). No additional data about this species have been published after that paper.

The well-known scarcity of data on the genus has recently been exacerbated by the fact that the holotypes and some additional specimens of the type series of *L. melanica*, *L. luismoojeni* and *L. picinguaba*, housed at the Museu Nacional of the Universidade Federal do Rio de Janeiro (Pinto & Carvalho, 2010), were lost in the fire of 2 September 2018. This fire, in the year of the 200th anniversary of the institution, destroyed almost all of the museum's entomological collections (Kury, Giupponi, & Mendes, 2018). The museum was the place where Brazilian odonatology was founded, due to the pioneer Dr Newton Dias dos Santos (Costa & Mascarenhas, 1998; Machado & Costa, 1990; Pinto, 2016). It was the first scientific institution in Brazil and the largest museum of natural history in Latin America, estimated to house 20 million items (Zamudio et al., 2018). Since the material of *Lauromacromia* burned down with the building, only 22 adult specimens in other collections are left, and about 73% of them belong to *L. picinguaba*. Some species, for instance *L. melanica*, are no longer represented by a single specimen in collection. On the upside, two female paratypes of *L. picinguaba* were saved from the destruction caused by the fire because they were out on loan. Additionally, the DNA of all known species of *Lauromacromia* have been extracted and some target loci have been already sequenced (Ware & Pinto, 2015).

The goal of this study is to describe, illustrate and diagnose the female of *L. luismoojeni* for the first time and to provide new occurrence records of *L. dubitalis*, *L. luismoojeni* and *L. picinguaba* for Brazilian states. In addition, the current knowledge for the genus is revisited and discussed.

Material and methods

The material examined is deposited in the following institutions: ABMM – Coleção Angelo Barbosa Monteiro Machado, Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brazil; DZRJ – Coleção Entomológica Prof. José Alfredo Pinheiro Dutra, Departamento de Zoologia, Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil; DZUP – Coleção Entomológica Pe. Jesus Santiago Moure, Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, PR, Brazil; MNRJ – Departamento de Entomologia, Museu Nacional, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil; MZSP – Serviço de Entomologia, Museu de Zoologia, Universidade de São Paulo, São Paulo, SP, Brazil; MPEG – Coleção Entomológica, Museu Paraense Emílio Goeldi, Belém, PA, Brazil.

The terminology for the external morphology follows Asahina (1954) and Garrison, von Ellenrieder, and Louton (2006), with spelling standardization based on Maggenti and Gardner (2005). Wing venation terminology follows Riek and Kukalová-Peck (1984) with additions by Fleck et al. (2003).

List of abbreviations: Ax = antenodal vein; Fw = forewing; Hw = hind wing; Px = postnodal vein; S1–10 = abdominal segments 1 to 10; TC = transverse carina.

The photographs were taken using a stereomicroscope Leica MZ16 (Wetzlar, Germany) equipped with a Leica DFC 500 (Leica LAS 3D and LAS MONTAGE version 4.7). The measurements and illustrations were made with the aid of stereomicroscopes equipped with a

camera lucida. Diagrammatic vector drawings were created using the freeware Inkscape (version 0.92, <https://inkscape.org/about/license/>).

Synonymies were elaborated consulting references with citations of the species-group names located using standard online databases (e.g., Web of Science). The distributional records from literature and specimen labels were compiled into a digital database. Coordinates missing from labels or original publications were taken from IBGE (2011) and Google Earth Pro (version 7.3.2.5776, <https://www.google.com.br/earth/download/gep/agree.html>). The biogeographical regionalization of the Neotropical region follows the system of Morrone (2014) based on the shapefiles provided by Löwenberg-Neto (2014). A map was produced using the freeware QGIS 2.18.0, https://www.qgis.org/pt_BR/site/forusers/download.html.

Results

An updated map of the distribution of *Lauromacromia* is made available, from the review of the all occurrence records in the literature, and new records (Figure 1). *Lauromacromia dubitalis* from the Amazonia domain is the most widely distributed species in the genus with records from Brazil, French Guiana and Venezuela. The previously known Brazilian records for this species were based on larvae, from sites in the states of Amazonas and Pará (Figure 1); no adults had been registered from that country. *Lauromacromia luismoojeni*, previously represented by two males collected in the 1960s, belongs to the Cerrado species group and its distribution is restricted to the cerrado of the states of Distrito Federal (holotype), and Mato Grosso do Sul in the Chacoan dominion (Figure 1). *Lauromacromia picinguaba*, which belongs to the Atlantic forest group, is restricted to the state of São Paulo (Figure 1). It is the only species for which a female has been described.

We examined 10 specimens of three species of *Lauromacromia* and four new locality records were detected in this study (Figure 1): based on a male, *L. dubitalis* (Figure 2) is recorded for the state of Amapá; based on adults and larvae, *L. picinguaba* is recorded for the state of Paraná, and based on a female, *L. luismoojeni* (Figure 3) is recorded for the state of Goiás.

Through examination of additional specimens of *L. picinguaba* we observed differences in coloration, mostly in the size of pale spots. Some specimens have larger spots and others have smaller and narrower spots (Figure 4C, D). The basal spots of the wings vary in size and color among paler and darker specimens.

The female from the state of Goiás was associated to *L. luismoojeni* largely based on the collecting site and general coloration, which we believe is diagnostic at the species level, such as yellow costal margin of the wings (Figure 3A), and distribution of pale spots (Figures 3A–D, 4A, B). When compared with *L. picinguaba*, differences were observed in the shape of the subgenital plate and coloration.

Lauromacromia dubitalis (Fraser, 1939)

<http://zoobank.org/7948C41A-E805-496A-941F-BCE88BC3CE7F>

(Figures 1, 2)

Gomphomacromia dubitalis Fraser, 1939: 91–93, figs 1a, b (description of male holotype, FRENCH GUIANA, Departement de la Guyane: Saint-Laurent du Maroni commune, Ex-K. J. Morton collection in NHMUK, illustrations of S10 and caudal appendages in dorsal and lateral views). —Santos (1967: 113, mention).

Lauromacromia dubitalis (Fraser, 1939): —Geijskes (1970: 4, 9, 10, 35, figs 1–2, comb. nov., illustrations of S2 of male holotype in lateral view, reproduction of illustrations from Fraser (1939)); —Davies and Tobin (1985: 70, catalog); —De Marmels (1985: 87, record for

Venezuela); —De Marmels (1990: 339, mention); —Garrison (1991: 21 synonymic list [updated version Garrison 1991]); —Machet (1991: 14, record for French Guiana); —May (1992: 20, comparison with *L. luismoojeni*); —Bridges (1994: III.25, VI.3, VII.73, VIII.34, catalog); —Steinmann (1997: 281, 282, catalog); —Fleck (2002: 223–227, figs 1–8, description of putative F-0 larvae, illustrations of habitus in dorsal view, head in dorsolateral view, distal margin of palpus in anterior view, S7–8 in dorsal view, abdomen in lateral and ventral views, wing sheath in lateral view); —Machado (2002: 316–317, comparison with *L. flaviae* and *L. luismoojeni*); —Carvalho, Salgado, and Fleck (2008: 1, 2, 8, comparison with *L. dubitalis*, *L. flaviae* and *L. picinguaba*); —Machet (2004: 148, list); —Machado (2005: 453–455, comparison with *L. bedei*, *L. flaviae* and *L. luismoojeni*); —Paulson (2004: 168, list); —Heckman (2006: 78, figs 3.2.50, key, reproduction of illustrations of ♂ holotype from Geijskes (1970)); —Garrison et al. (2006: 145, 149, 160–161, 338–341, figs 780, 783, 818, 882–884, illustrations of wings, genital fossa in lateral view, S10 and caudal appendages in lateral and dorsal views all based on photos from the male holotype); —Araujo and Beserra (2007: 321, as food of Yekuana group of Alto Orinoco); —Pinto and Carvalho (2010: 46–47, 53–55, 58–64, 68, figs 18–21, illustrations of vesica spermalis in lateral and dorsal views from Venezuela, map of distribution, comparison with *L. bedei*, *L. flaviae*, *L. melanica*, *L. luismoojeni* and *L. picinguaba*, key, phylogenetic analysis, biogeography); —Pinto and Lamas (2010: 614, records from Brazil); —Fleck and Legrand (2013: 585, mention).

Type specimen

Holotype ♂, by monotypy, French Guiana [French Guiana, Departement de la Guyane, Saint-Laurent du Maroni commune] deposited in The Natural History Museum, London, UK (NHMUK, examined by photo).

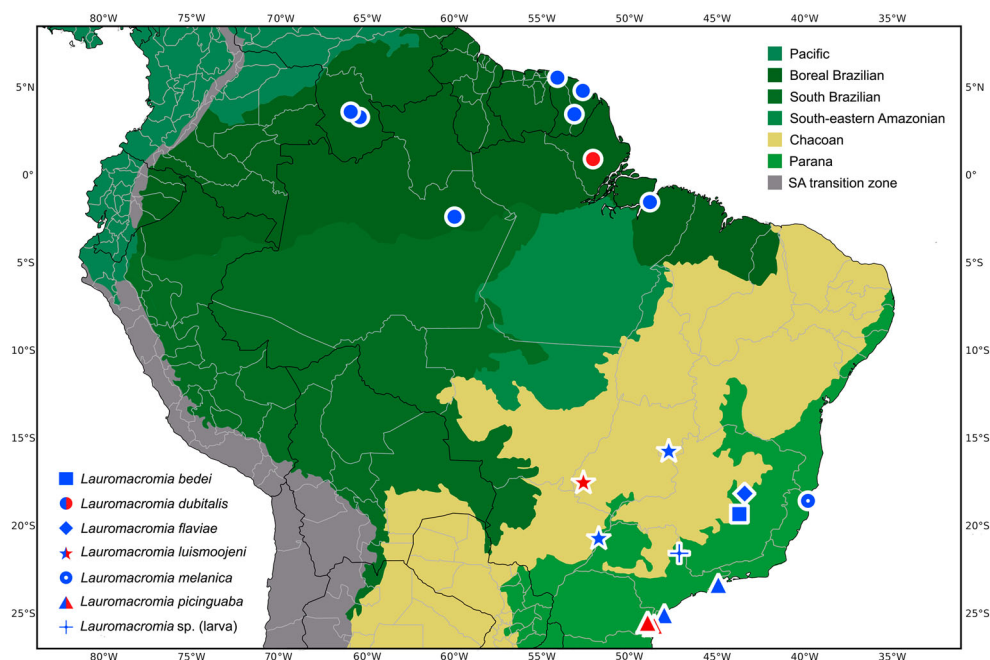


Figure 1. Distributional records of *Lauromacromia* species. Blue symbols represent the previously published records and red symbols represent new records, first published in this study. Biogeographical regionalization at the level of dominion was based on Morrone (2014).

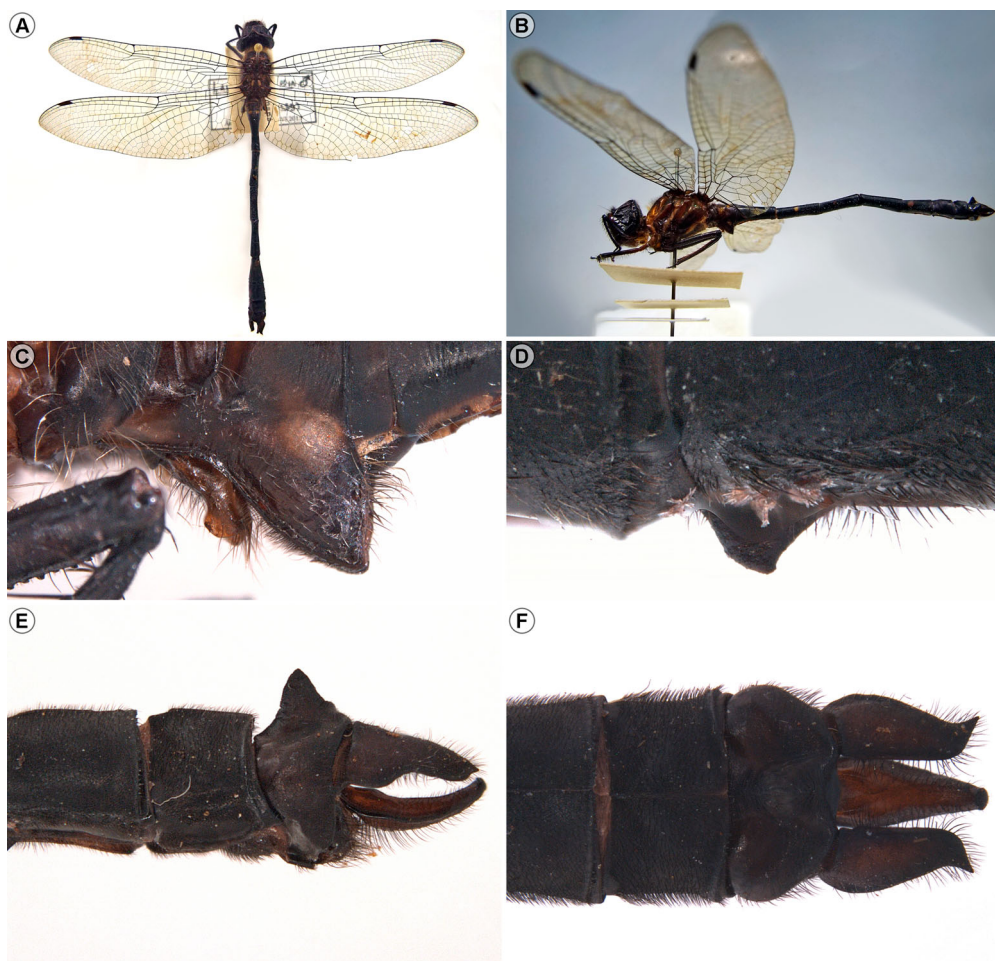


Figure 2. Male of *Lauromacromia dubitalis* (Fraser, 1939) (Amapá, MPEG). (a) Habitus in dorsal view; (b) habitus in lateral view; (c) genital lobe and posterior hamule in lateral view; (d) sternal process of S8; (e) S8–10 and caudal appendages and mesal process of S10 in lateral view; (f) S8–10 and caudal appendages in dorsal view.

Material examined (1♂). BRAZIL, Amapá State: 1♂, Serra do Navio Municipality, 16 May [19]89, L. Goyareb leg. (MPEG 05000421).

Remarks

When compared with the holotype, the male from Amapá has the proportion between the cercus and the epiproct significantly different, the epiproct exceeds posteriorly the length of the cercus (epiproct about 1.1 times of cercus length; in the holotype the epiproct reaches posterior 0.85 of cercus). In addition, the hamule is slightly more acute laterally. This is the first record of occurrence of *L. dubitalis* in the state of Amapá and validates previous records known to Brazil based on larvae (Pinto & Carvalho, 2010).

Lauromacromia picinguaba Carvalho et al., 2004

<http://zoobank.org/zoobank.org:act:C2BABF3B-1928-4992-BCFC-1DA7613F4C6F>

(Figures 1, 4C, D)

Lauromacromia picinguaba Carvalho et al., 2004: 2–10, figs 1–7 (description of the male holotype, BRAZIL, São Paulo State: Ubatuba municipality, [Serra do Mar State Park], Picinguaba district, 26–27 October 2001, A.L. Carvalho & L.G.V. Salgado leg. in MNRJ [lost in the fire], habitus in lateral view, illustrations of vesica spermalis in lateral and ventral views, S2 in lateral view, S8–10 and caudal appendages in lateral view of the male holotype, habitus in dorsal view, S7–10 of female paratype in ventral view, comparison with *L. dubitalis*, *L. flaviae* and *L. luismoojeni*); —Machado (2005: 453–455, comparison with *L. bedei*, *L. flaviae* and *L. luismoojeni*); —Heckman (2006: 80, figs 3.2.52, key, reproduction of illustrations from Carvalho et al. (2004)); —Garrison et al. (2006: 160, mention); —Carvalho et al. (2008: 57, 59–63, figs 1–9, description of larvae, habitus in dorsal view, illustrations of head, prementum, labial palpus and caudal appendages in dorsal view, mandibles in internal view, abdomen in lateral and dorsal views of larvae, comparison with *L. dubitalis*); —von Ellenrieder (2009: 63, 64, list); —Pinto and Carvalho (2010: 45–47, 54, 55, 58–64, figs 2, 19–21, 23, diagrammatic illustration of synthorax, habitus of the male holotype, map of distribution, comparison with *L. bedei*, *L. dubitalis*, *L. flaviae*, *L. melanica*, and *L. luismoojeni*, key, phylogenetic analysis, biogeography); —Pinto and Lamas (2010: 613–615, comparison with *Navicordulia errans* Calvert, 1909, *Na. aemulatrix* Pinto and Lamas, 2010, *Neocordulia setifera* Hagen in Selys, 1871, *L. luismoojeni* and *L. melanica*); —Garrison and von Ellenrieder (2016: 50, catalog [printed version Garrison (1991)]).

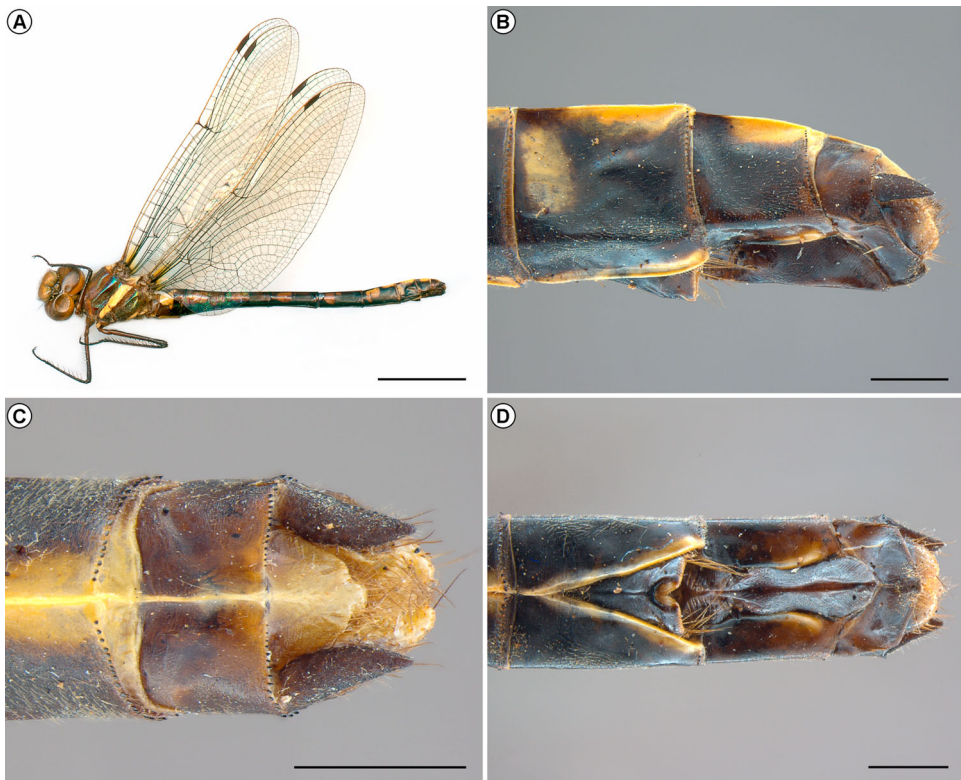


Figure 3. Female of *Lauromacromia luismoojeni* (Santos, 1967) (Goiás, ABMM). (a) Habitus in lateral view; (b) S8–10, subgenital plate and caudal appendages in lateral view; (c) S9–10 and caudal appendages in dorsal view; (d) S8–10, subgenital plate and caudal appendages in ventral view. Scale bars = 1 mm.

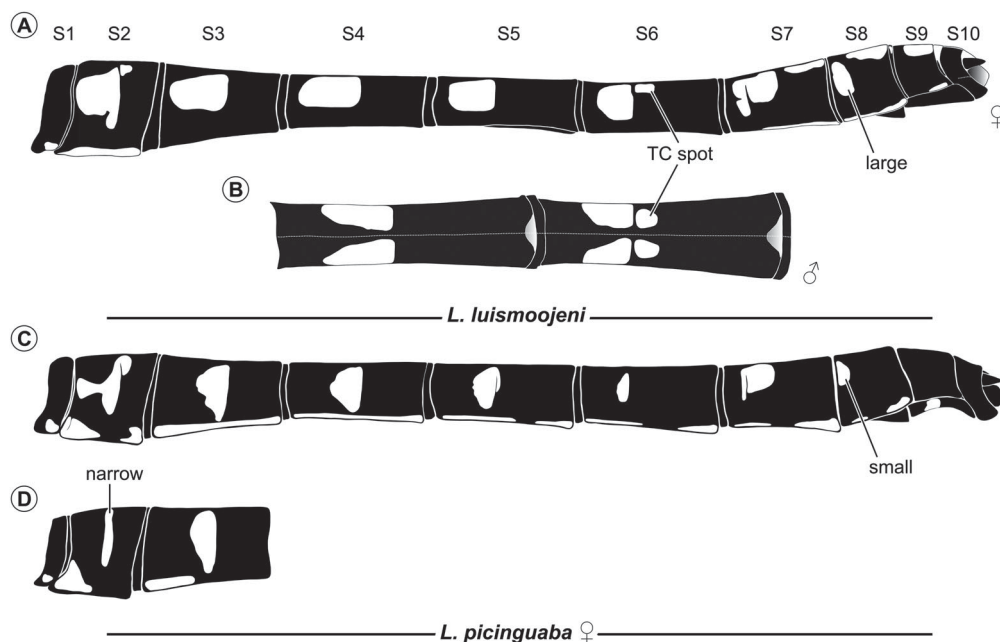


Figure 4. Diagrammatic representation of the abdomen coloration of *Lauromacromia* species. (a, b) *Lauromacromia luismoojeni* (Santos, 1967), (a) S1–10 of female (Góias, ABMM) in lateral view, and (b) S5–6 of male (Mato Grosso do Sul, MZSP) in dorsal view; (c, d) *Lauromacromia pinguaba* Carvalho et al., 2004 (São Paulo, DZUP), (c) S1–10 of female in lateral view, and (d) detail of S1–3 of other female.

Type specimen

Holotype ♂ by original designation (Carvalho et al., 2004) in MNRJ. Lost in the fire. BRAZIL. São Paulo State: Parque Estadual da Serra do Mar, Núcleo Picinguaba, 12 October 2001 [adult's emergence data], Carvalho, A.L. & Salgado, L.G.V. leg, examined, subsequently lost (see Remarks); same data as holotype 2♀ paratypes, BRAZIL. São Paulo State: Ubatuba municipality, Picinguaba district, Parque Estadual da Serra do Mar (DZRJ).

Material examined (8♀, 9♂ and 1 F-0 exuviae). BRAZIL. São Paulo State: 7♀ and 7♂, Cananéia municipality, Parque Estadual da Ilha do Cardoso 25.082222° S 47.927222° W, 19–22 October 2011 (DZUP 500173-500180; MZSP); Paraná State: 1 exuviae F-0, Morretes municipality, América de cima district, Brumado river 25.506944° S 48.885° W, 18 October 2017, A.P. Pinto, J. Ehlert, B.R. Araujo and L.E. Santos leg, (DZUP 500205); 1♂, Pontal do Paraná municipality, Praia do Atami, 26 December 2004 [O.H.] Mielke leg (ABMM); 1♀ and 1♂, same but 31 December 2007 (ABMM).

Remarks

New records from the state of Paraná based on males, females and larvae from the municipalities of Morretes and Pontal do Paraná. Specimens from Paraná and south of São Paulo vary in color, some have darker basal spot and smoky wings. In the darker specimens the pale yellow spots are smaller, while the lighter specimens have larger spots (Figure 4). The holotype deposited in the Museu Nacional collection was lost in the fire; however, images of the habitus and labels data had been scanned and two paratypes under loan are safe.

***Lauromacromia luismoojeni* (Santos, 1967)**

<http://zoobank.org/5009A035-AA5A-43BF-A96D-3C8441C15396>

(Figures 1, 3, 4A, B)

Neocordulia luis-moojeni Santos, 1967: 113, 114, figs 1–8 (description of male holotype, BRAZIL, Goiás [sic, Distrito Federal] State: Brasília municipality, illustrations of vesica spermalis in lateral view, S2 in lateral and ventral views, caudal appendages in ventral, lateral and dorsal views, synthorax and abdomen in lateral view, S8 sternite in ventral view); —Davies and Tobin (1985: 70, catalog); —May and Knopf (1988: 40, 41, comparison with *Neocordulia androgynis* (Selys, 1871), *N. batesi batesi* (Selys, 1871), *N. biancoi* Rácenis, 1970, *N. campana* May & Knopf, 1988, *N. carlochagasi* Santos, 1967, *N. longipollex*, *N. setifera* (Hagen in Selys, 1871) and *N. volxemi* (Selys, 1874)).

Lauromacromia luismoojeni (Santos, 1967): —Garrison (1991: 21, comb. nov., synonymic list [updated version Garrison & von Ellenrieder, 2016]); —May (1992: 20, comparison, spelling amended); —Bridges (1994: VII. 139, VIII. 34, catalog); —Machado and Costa (1995: 191, comparison with *Navicordulia*); —Costa and Mascarenhas (1998: 15–16, type catalog); —Machado (2002: 313, 316, 317, comparison with *L. dubitalis* and *L. flaviae*); —Carvalho et al. (2004: 1, 8, comparison with *L. dubitalis*, *L. flaviae* and *L. pinguaba*); —Machado (2005: 453–455, comparison with *L. bedei*, *L. dubitalis* and *L. pinguaba*); —Heckman (2006: 79, key); —Garrison et al. (2006: 160, mention); —Pinto and Carvalho (2010: 45–47, 49–50, 52–55, 58–64, figs 3–4, 6, 8–11, 15–16, 19–21, 24–25, diagrammatic illustration of synthorax of males in lateral and ventral views, habitus of the male holotype, S8 in lateral view, caudal appendages and mesal process on S10 in lateral view, detail of left cercus in ventral view, vesica spermalis in lateral view, comparison with *L. dubitalis*, *L. bedei*, *L. flaviae*, *L. melanica* and *L. pinguaba*, key, phylogenetic analysis, biogeography distribution); —Pinto and Lamas (2010: 2010: 613–615, comparison with *Na. errans*, *Na. aemulatrix*, *Ne. setifera*, *L. melanica*, and *L. pinguaba*).

Type specimen

Holotype ♂ by original designation (Santos, 1967) in MNRJ. Lost in the fire. BRAZIL, Distrito Federal: Brasília, Rio [São] Bartolomeu, 26 November 1963, N.D. Santos, J.P. Machado, C. Borges & L. Moojen leg. (MNRJ 775), subsequently lost (see Remarks).

Material examined (1♂ and 1♀). BRAZIL. Goiás State: 1♀, Mineiros municipality, October 1994, [O.] Roppa leg. (ABMM); Mato Grosso do Sul State: 1♂, Três Lagoas municipality, [boundary with Castilho municipality in São Paulo State], October 1964[?], without collector (MZSP).

Diagnosis

Predominantly brown corduliid with metallic green reflections on thorax, pale yellow spots and stripes, anal loop with no Cuspl, heel and toe (sac-like) typical of *Lauromacromia* (cf. Garrison et al., 2006; Pinto & Carvalho, 2010). Males and females of *L. luismoojeni* are distinguished from all other species in *Lauromacromia* by the yellow costal margin in the wings, yellowish color of dorsal surface of antealar sinus, larger size of dorsolateral pale spot on S8 and wider metepisternal stripe with maximum width vs. maximum width between the mesopleural and metapleural sutures ≥ 0.36 (costal margin and antealar sinus brown to black, metepisternal stripe narrower, ratio ≤ 0.33).

Male cerci with tips almost parallel sided in dorsal view, bluntly pointed, length about 1.5 times longer than S10, ventral surface with a separate knob-like process (tubercle), S8 sternal

process curved and yellow spots posterior to transverse carina on S6 distinguish *L. luismoojeni* from species of the Amazonian group (*L. dubitalis*, tips of cerci divergent and acute pointed, ≤ 1.0 times longer than S10, ventral surface lacking tubercle and S6 posterior to TC brown, lacking pale spots) and Atlantic Forest group (*L. melanica* and *L. picinguaba*, tips acute pointed, ≥ 2.0 times longer than S10, ventral surface lacking a separate tubercle, S8 sternal process not definitely curved and S6 posterior to TC brown, lacking pale spots). The yellow spot posterior to TC on S6 (Figure 4, TC spot) is shared with *L. bedei* and *L. flaviae*, the other members of the Cerrado's species group. The yellow spots anterior to TC on S5–6, brown color posterior to TC on S4, lacking pale spots, and the dorsolateral pale spot on S8 distinguish *L. luismoojeni* (Figures 3A–D, 4A, B) from *L. flaviae* (S5–6 posterior to TC brown, pale spot posterior to TC on S4 and S8 brown, lacking pale spots). Males of *L. luismoojeni* are most similar to *L. bedei* but can be mainly distinguished from it by the larger pale areas, metepisternal stripe 2.5 times wider and size of yellow spot on S8. Further the mesal expansion on S10 is largely obtuse in *L. luismoojeni* (slightly triangular in *L. bedei*).

In addition, *L. luismoojeni* has yellow pale spots on all abdominal segments. This differs from *L. dubitalis* (yellow spots on S2–7), *L. melanica* (yellow spots on S1–2 and S7), *L. picinguaba* (yellow spots on S1–8), *L. flaviae* (yellow spots on S1–7) and *L. bedei* (yellow spots on S1–9).

Description of the female

Head. Labium yellowish-orange with inner margin of labial palpus with dark brown spot occupying 0.14 of total width. Labrum yellowish-orange. Clypeus greenish-yellow; anteclypeus with a pair of triangular dark marks, base of triangles at clypeal suture. Antefrons yellowish-orange, greenish-yellow laterally, anterior surface with well-defined punctures; postfrons greenish-yellow, dark brown spot at front of the median ocellus narrowing along the median deep furrow. Antenna dark brown. Vertex dark brown, an ill-defined rounded yellow spot dorsally. Occipital triangle dark brown, yellow mesally; projected dorsally higher than eye level. Posterior region of head black.

Thorax. Prothorax whitish-yellow; posterior lobe trapezoidal, posterior margin with a median small concavity. Synthorax ground color dark brown, mostly with metallic green reflections, less amount of blue and purple reflections; two light yellow stripes, one over the metepisternum and second divided on metepimeron into two spots, the most posterior running ventrally. Metepisternal stripe covering 0.75 of sclerite width, metepimeral stripe covering 0.2. Metapostepimeron yellow, light brown on anterior and black on posterior angles. Antealar and interalar sclerites yellow.

Wing. Membrane hyaline basally, distally very slightly tinged with yellow; venation dark brown to black, except for the whitish-yellow costal margin; pt brown; membranula white, extended to half of posterior cell of the first para-anal cell; basal spot golden yellow triangular, up to first Ax in the costal and subcostal space in all wings. Venation as follows: Ax: 10 in Fw, 6 in Hw; Px: 6 Fw, 7–8 Hw; arc between 1st and 2nd Ax, closer to the second; sectors of arc not stalked and non-fused, origin located basal 0.20 in Fw, 0.25 in Hw; one bridge crossvein in all wings; Rspl edges ill-defined with 8 cells in Fw, 9–10 in Hw; discoidal triangles, subtriangles and supratrangles not crossed (one celled) in all wings; space between CuP-crossing and base of triangle not crossed in Fw and with one crossvein in Hw; Fw discoidal field with 9–10 rows of one cell up to level of nodus, followed by 6 rows with 2 cells increasing to 4–5 cells at wing margin; Hw discoidal field divergent, starting with one cell, followed by 4 rows of 2 cells slightly distal to RP-midfork, one row of 3 cells increasing to 10 at wing margin; Mspl indistinct in all wings; anal loop sac-like with 13 cells, lacking Cuspl, heel and toe, distal edge at distal angle of the discoidal triangle;

space between anal loop and the anal margin of the wing (anal field) with 2–3 cells rows. PsA in Fw near to the angle of the discoidal triangle.

Abdomen (Figures 3, 4A). Tergites ground color dark brown on S1–3 darkening to black on S4–10, with yellow spots in all segments, no evident metallic reflections. A single anteroventral small spot on S1; large stripe on S2 covering ventral 0.15, narrowing on S3–6, darkening and almost limited to ventral carina, gradually enlarging posteriorly on S7–9; anterolateral spot anterior to TC on S2–8; a small rounded spot posterior to TC on S2 and a larger one on S7; posterodorsal pale spot covering from 0.4 to 0.7 of segment length on S7–9 respectively, very reduced on S6 and barely defined on S10. Sternites dark brown to black. Subgenital plate, rectangular, posterior margin truncated (see Discussion) reaching about posterior 0.1 of S9 length in ventral view; a large semicircular carina with a yellow triangular slit; posterior margins covered with long yellow setae laterally. Epiproct light yellow, triangular, reaching 0.6 of cercus. Paraprocts basally dark brown to brown lightening to light yellow distally. Cercus dark brown.

Measurements (mm)

Total length 49; width of head 7.2; total length of thorax 8.7; eyes seam length 0.5; length of metepisternal stripe 5.4; width of medial portion of metepisternal stripe 1.1; length of metepimeral stripe 2.0; length of Fw 33–34; width of Fw 8–7; length of Fw pt 2.8–2.9; post nodal space 0.27 in Fw, length of Hw 32–33; width of Hw 10.6; length pt of Hw pt 3–2.9; length of hind femur 7.5; length of hind tibia 7.8; total length of abdomen 36; length of subgenital plate 2.5; length of epiproct 0.7; length of cercus 1.0; ratio between length of subgenital plate and S8 total length 0.9.

Remarks

The abdomen is broken between S5 and S6. The setae on the posterior margin of the subgenital plate are limited to the lateral edges. However, there are insertion sites of the setae which indicate that the entire posterior margin of the plate was originally covered by setae. The holotype was lost in the fire of 2018, but images of the habitus, of the diagnostic characters and labels were photographed (Pinto & Carvalho, 2010).

Discussion

The assembled knowledge on the morphology and distribution of *Lauromacromia* is based on very few specimens. This has biased both our taxonomic and evolutionary knowledge about this genus. For instance, four of its six species are known from very small type series, one or two specimens, which altogether corresponds to about 27% of the specimens held in collections. If the loss of the type series of *L. melanica* and the holotype of *L. luismoojeni* are taken into account, this percentage is reduced to about 14%. These scant data available make it difficult to determine interspecific limits in the genus and to estimate the morphological variation, such as the distribution of the pale spots. Pinto and Carvalho (2010) provided a key largely based on the distribution of pale spots, from data available in the literature (e.g., Machado, 2005). However, upon reviewing the material, including the additional specimens in this work, we noticed that only S6 had spots posterior to TC in specimens of *L. luismoojeni* instead of S5–6, as indicated in the key. Even though this statement is based on interpretation, more material will enable further studies on several aspects of its species and result in a more robust knowledge.

The new specimen of *L. luismoojeni* is the first female from the Cerrado species group and can now be compared with the only other female of genus, which belongs to the Atlantic Forest species group. Females of *L. luismoojeni* and *L. picinguaba* mainly differ in coloration, which was expected, since other dragonflies of the Cerrado are lighter than their Atlantic Forest counterparts (APP, pers. obs.). *Lauromacromia luismoojeni* is lighter than *L. picinguaba*, with large yellow spots on all segments. Also, *L. picinguaba* has darker ground color, tending to black, while *L. luismoojeni* is largely brown to dark brown. The yellow costal margin of the wing in *L. luismoojeni*, an important character for species determination first observed by Machado (2002), was corroborated as useful after study of the female, since in all other species the costal margin is dark brown.

All females of *Lauromacromia* deposited in collections are slightly to deeply smashed, making accurate comparisons difficult. However, we observed differences in the shape of the subgenital plate. In the female of *L. luismoojeni* the posterior margin is truncated with a triangular slit, while in *L. picinguaba* the posterior margin is also truncate, but it appears that the ends of each side of the slit are in contact, giving the impression of continuity. This difference may be related to the fact that the abdomen of *L. picinguaba* was flattened laterally due to the fact that it was preserved during its prereproductive period (cf. Pinto, 2019).

In addition, an important character is the maximum width of the metepisternal stripe compared to the maximum width of the metepisternum (between the mesopleural and metapleural sutures), which enable sorting of the species of the genus into narrow- and wide-striped species as follows: below or equal to 0.25 (*L. flaviae* = 0.24; *L. melanica* = 0.21; *L. bedei* = 0.16) and above or equal to 0.33 (*L. picinguaba* = 0.33; *L. luismoojeni* = 0.36).

The distribution of *L. picinguaba* appears to be restricted to restinga or at least largely coastal forest formations (Pinto, 2019). The F-0 exuvia was found on the abaxial surface of the leaf of a young tree, a few centimeters from the ground. This was the first time that a larva of this species has been recorded from a river, differently from previous localities in which larvae were collected in intermittent pools associated with sandy and muddy substrates (Carvalho et al., 2004, 2008; Pinto, 2019). However, the new site presents a very similar mesohabitat, because apparently the larvae were associated with the bottom the leaf litter in a river reach. The site forms a loop in the river's margin and constantly receives water, looking like a puddle. The vegetation, soil and physiognomy of the new record in Praia do Atami in Paraná is strongly similar to the locality of the recently discovered population in the southern state of São Paulo (Pinto, 2019). Although Morretes is not littoral, lowland areas in this municipality are strongly influenced by the coast.

Although the first records for *L. dubitalis* from Brazil were based on a few larvae, apparently this species is very common in northern Brazil, since different collections house material and distinct campaigns regularly sampled larvae of this species (APP, pers. obs.).

The findings here appear to support the correspondence among phytogeographical domains and phylogenetic relationships. An interesting further step is to investigate the time of divergences among lineages, with the goal to infer the processes that modeled the spatial evolution in the genus.

Finally, the rarity of this genus can be misleading, as was discussed in length before (cf. Pinto, 2019 and references therein). Most likely it reflects a sample bias rather than a natural phenomenon.

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